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Management Systems Review of the Superfund RI/FS Opportunities for Streamlining

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The Management Systems Review (MSR) is an important component of EPA's quality assurance program to assess the effectiveness of environmental data operations and the quality assurance/quality control activities designed to support those operations. MSRs inform managers about aspects of the environmental data operation that are working well and those which may warrant some improvement. A recent review of the Superfund remedial investigation/feasibility study (RI/FS) has shown that the MSR is an excellent tool for providing a systematic definition of complex environmental data operations and for enabling a thorough analysis of these operations. The MSR utilized information gathered from interviews of Regional personnel and from case studies of recently completed RI/FSs. The findings indicated that environmental data play an important role in most RI/FS decisions and that thorough and structured scoping is critical to the effectiveness of the RI/FS. Analysis of the RI/FS process using a comprehensive flow diagram identified several opportunities for changes that may increase efficiency in data collection and the reliability of RI/FS decisions. These changes provide for more effective scoping activities, a streamlined feasibility study, and increased use of treatability studies during the RI. A pilot demonstration of these process changes is being planned for a Regional RI/FS.

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A Management Systems Review of the Superfund RI/FS: Opportunities for Streamlining

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The Management Systems Review is an important component of EPA's quality assurance program. MSRs enable managers to assess the effectiveness of environmental data operations and the quality assurance/quality control activities designed to ensure that the results are of the expected quality. These reviews inform managers about aspects of the environmental data operation that are working well and those which may warrant some improvement. A recent review of the Superfund remedial investigation/feasibility study (RI/FS) has shown that the MSR is an excellent tool for providing a systematic definition of complex environmental data operations and for enabling a thorough analysis of these operations. The MSR utilized information gathered from interviews of Regional staff and management and from case studies of recently completed RI/FSs. The findings indicated that environmental data play an important role in most RI/FS decisions and that thorough and structured scoping is critical to the effectiveness of the RI/FS. Analysis of the RI/FS process using a comprehensive flow model identified several opportunities for changes that may increase efficiency in data collection and the reliability of RI/FS decisions. These changes provide for more effective scoping activities, a streamlined feasibility study, and increased use of treatability studies during the RI. A pilot demonstration of these process changes is being planned for a Regional RI/FS.

The Management Systems Review (MSR) is an important component of the Environmental Protection Agency's quality assurance (QA) program. MSRs enable managers to assess the effectiveness of environmental data operations and the quality assurance/quality control activities designed to ensure that the results are of the expected quality. These reviews inform managers about aspects of the environmental data operation that are working well and those which may warrant some improvement.

The Office of Emergency and Remedial Response (OERR) invited the Quality Assurance Management Staff (QAMS) to perform a review of the Superfund remedial investigation/feasibility study (RI/FS) in order to provide an independent assessment of this important process. QAMS experience in management review techniques and environmental data operations provided a third-party review capability which met OERR's needs. This review confirmed that the MSR is an excellent tool for providing a systematic definition of complex environmental data operations and for enabling a thorough analysis of these operations. The purpose of this article is to share some important results from the recent Superfund review which may provide significant opportunities to streamline RI/FS operations and reduce costs.

The Management Systems Review

Over a decade ago, EPA recognized the need to ensure that the data being used for important decisions were of adequate quality for their intended use. The Administrator directed all EPA organizations participating in any aspect of environmental data operations to develop, implement, and review periodically a process for determining the quality of data produced by their operations.[1] Quality assurance programs were established throughout the Agency to provide this necessary function. As EPA's reliance on environmental data for enforcement, regulatory, and research decisions continued to grow, so did the importance of QA programs. In order to provide a tool for managers to assess the effectiveness of their QA programs, the Management Systems Review was developed.

The MSR is designed to evaluate systematically how QA and environmental data operations are planned, implemented, and reviewed. The MSR is not an audit, even though its function may appear to be similar. Audits measure conformance of systems to specifications of technical performance and quality. MSRs examine processes to define how they

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work. In some cases, performance measures may not exist. MSRs enable management to identify where an operation is working satisfactorily, and to consider where modifications to improve process effectiveness may be appropriate. The use of a process flow model is particularly helpful in enabling management to gain additional insights on the relationship of all activities in an operation, and to experiment with and see the impacts of potential process modifications. Such a detailed flow model of the RI/FS was utilized often during the Superfund MSR.

Goals of the Superfund Review

The collection and analysis of environmental data are the most significant cost and time components of the RI/FS.[2] These data are also key to the efficacy and reliability of important RI/FS decisions, such as determining if an unacceptable risk is posed by a site and selecting an appropriate remedy.

As part of its ongoing efforts to reduce costs and improve the effectiveness of Superfund activities, OERR requested that QAMS conduct a comprehensive review of the RI/FS process, focusing on the role of environmental data. The review had the following objectives:

- identify the RI/FS decisions that rely on environmental data;
- determine how data needs are defined and how their collection is planned and executed; and
- examine the impacts of the planning, collection, and use of RI data on the scheduling and quality of RI/FS outputs, including remedy selection.

The review was conducted by QAMS with the assistance of the OERR Hazardous Site Control Division and the Office of Program Management.

The RI/FS is a complex process involving several technical and scientific disciplines, participants with various backgrounds and data needs, and many interdependent steps. The approach of the MSR was to evaluate systematically how environmental data fit into the RI/FS, the critical decision points for which data are needed and when they occur, and where insufficient data could cause a schedule delay or adversely impact RI/FS decisions.

How the Review was Conducted

The Superfund MSR was conducted from September 1988 to April 1989 by a team of four reviewers, who coordinated their efforts with numerous Headquarters and Regional personnel. The MSR had three phases: Planning, Data Gathering, and Analysis and Development of Findings. These phases are discussed below.

Planning

In the planning phase, QAMS and OERR agreed on the scope and approach of the study which was documented in a plan outlining the schedule, participants, and the specific questions which OERR had about environmental data use in the RI/FS.

Documents such as QA program plans and RI/FS guidance provided a general blueprint of the data collection and QA operations, and gave a picture of how the RI/FS is supposed to operate. This information was used to define a process flow model of the major RI/FS activities, and to assemble these activities or steps into logical groups for data gathering and analysis. The model became a template for obtaining and organizing information during interviews with Regional personnel.

Data Gathering

Data gathering for the MSR involved interviews of more than 25 Remedial Project Managers (RPMs) and their management in three Regions. The interviews traced the logic and decision flow of the RI/FS, with emphasis on:

- the types of environmental data collected and how data needs were determined;

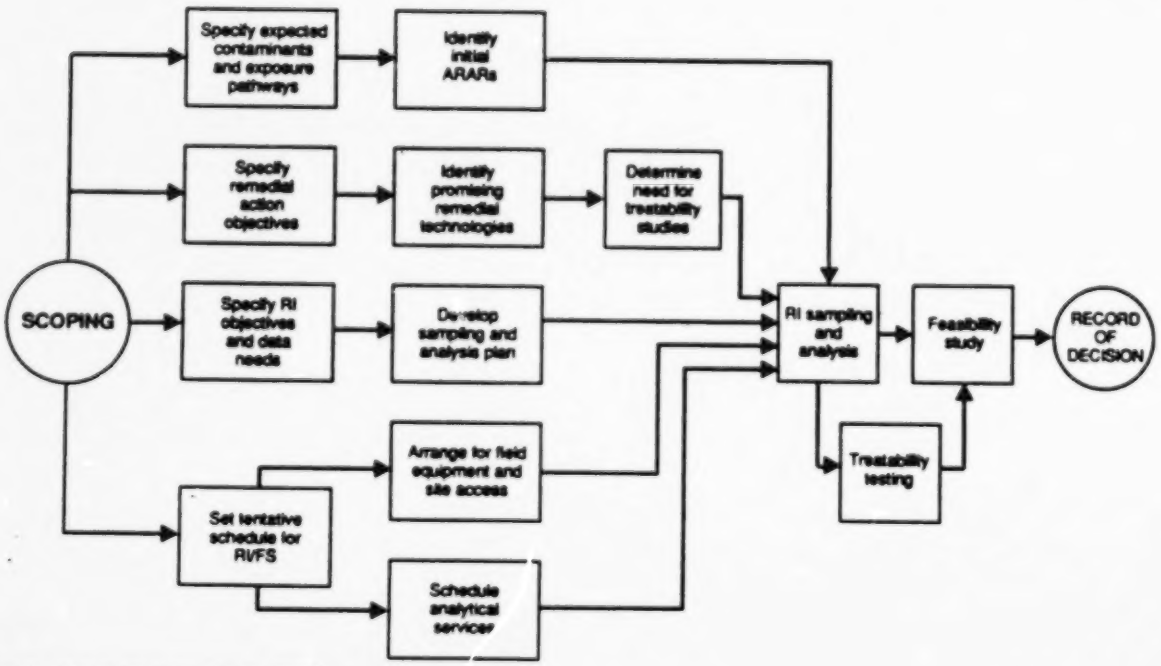
Specify expected contaminants and exposure pathways
Identify initial ARARs
Specify remedial action objectives
Identify promising remedial technologies
Determine need for treatability studies
SCOPING
Specify RI objectives and data needs
Develop sampling and analysis plan
RI sampling and analysis
Feasibility study
RECORD OF DECISION
Arrange for field equipment and site access
Treatability testing
Set tentative schedule for RI/FS
Schedule analytical services

Figure 1. Outputs of scoping drive the RI/FS process.

- the participants in RI/FS scoping and their roles;
- the way in which remedial alternatives were identified, evaluated, and selected;
- how the RPM decides that sufficient RI data have been collected; and
- factors that facilitated or impeded timely, effective remedial investigations.

Just as the review of Superfund planning documents and guidance helped to formulate a framework for the flow model and to describe how the RI/FS process was supposed to operate, the interviews showed how the RI/FS was performed in practice. There was significant variability among RI/FSs within a Region and across Regions. However, the planning and site investigation activities were sufficiently similar to describe a typical or representative RI/FS, which was used as a basis for analyzing the process.

In order to validate the process captured in the flow model and to add to our understanding of how environmental data were being used, case studies were obtained for eight sites. These sites were identified by the Regions as fairly typical sites and had Records of Decisions (RODs) completed in 1987 or 1988 to ensure that they reflected recent procedures. The case study documentation generally included the work plan, sampling and analysis plan, quality assurance project plan, RI report, FS report, and ROD for each site. This information was critical to understanding what data were typically collected and how the data were used in making site-related decisions.

Analysis and Development of Findings

When the data from the interviews and case studies had been integrated into the process flow model, they were analyzed with respect to the study objectives. In addition, QAMS augmented this data base with information from a 1987 MSR of Superfund QA programs in six Regions. During the 1987 study, more than 40 RPMs and managers were interviewed about the RI/FS. These data helped to confirm the common decisions and factors affecting RI/FS implementation in most Regions.

Many of the steps in the RI/FS process depend to some degree on environmental data. The flow model simplified the identification of the major decisions that rely on data. These are: assessment of risk and determining if the no-action alternative is appropriate for the site; identification and screening of remedial process options; and screening, evaluation, and selection of remedial alternatives. Having confirmed the specific and critical role of environmental data in the RI/FS (the first objective of the MSR), we used the flow model to document the process typically used by the Regions for defining data needs and for planning and executing field sampling activities (the second MSR objective).

Further analysis indicated several opportunities for process changes related to the third objective of the MSR: how the collection and use of environmental data impacts the scheduling and quality of RI/FS outputs. Many of the proposed modifications apply to scoping. Because of its pivotal role in defining data needs and sampling activities, changes implemented in scoping can have great impact on subsequent RI/FS steps and outputs. The analysis also showed that several modifications to steps involving RI field sampling and treatability studies had the potential to produce additional time and cost savings. These findings generally agree with suggested program modifications endorsed by Superfund in its recent "90-day Study."[3]

Findings of the RI/FS Review

The following discussion outlines the changes to scoping and the feasibility study which have significant potential for streamlining the RI/FS and increasing the reliability of decisions that depend on data. Opportunities for RI/FS streamlining can be summarized as follow:

- Know when to stop sampling;
- Reduce the number of unplanned sampling episodes;
- Reduce false starts and rework through structured planning;
- Begin feasibility study during scoping;
- Reduce the number of alternatives considered and evaluated during the feasibility study; and
- Conduct treatability studies during remedial investigation field work.

Scoping

Scoping is critical to the success of the RI/FS because it sets the stage for all subsequent activities (see Figure 1). One function of scoping is to pose the questions that will capture the information needed to determine the nature and extent of contamination at the site and to support the selection of an effective remedy. Scoping typically involves many participants including the RPM and the RPM's management, other data users such as risk assessment staff and legal counsel, QA staff from the Environmental Services Division, representatives from other EPA programs like RCRA, the remedial contractor, and State and local agencies.

The MSR found that scoping varied widely among the Regions in terms of how it was conducted, who was involved, and the effectiveness of the results. This allowed the MSR team to identify several issues that impact the efficiency and utility of the scoping process. The following discussions of these issues and possible solutions underscore the importance of scoping to the RI/FS.

Know when to stop sampling. During the interviews in the Regions, each RPM was asked: how do RPMs decide when they have enough of the right kinds of data to stop RI sampling and proceed with the feasibility study? That is, how do RPMs know when they have adequately characterized the nature and extent of contamination at a site in order to select a remedy? To answer this question, several subordinate questions needed to be addressed:

- What are the qualitative or quantitative criteria which RPMs use to decide that the appropriate data have been obtained?
- If criteria are used, how are they applied? Are these criteria explicitly tied to RI objectives defined in scoping?
- What role do budget and time constraints play in determining when RI data collection stops?

We found that the decision to end RI sampling was a subjective one based on many, largely qualitative factors. The professional judgement of the RPM, the RPM's management, and the contractor were used to determine if the data "adequately" describe the nature and extent of site contamination. Adequacy of the data was interpreted differently among RPMs. This variability is understandable since there is limited guidance or statistical expertise available to RPMs to help them make these decisions in a more quantitative way.

The uncertainty associated with how much data are enough may cause more data to be collected than is really needed, perhaps through unplanned field sampling activities. This uncertainty is increased by the demands for RI data by various data users who participate in scoping and seek the data needed to perform their part of the RI/FS, such as ground water modeling. The RPMs must balance competing data needs against the constraints of budget and schedule to develop a workable plan for studying the site. Without quantitative specifications for the type, amount, and quality of data needed to make RI/FS decisions, it is not

possible to say whether collected data were excessive, inadequate or sufficient for the purposes at hand.

We believe that it is feasible to develop a statistically-based approach to sampling which enables a quantitative determination of when sufficient sampling has occurred. A detailed discussion of an approach to developing quantitative specifications is beyond the scope of this paper, but has been described by Neptune, et al.[4] At a minimum, however, specifications should include: a statement of each of the primary decisions to be made in the RI (e.g., determining if unacceptable levels of contamination exist on site, evaluating and selecting remedial alternatives); the inputs needed for each of those decisions (e.g., identification of contaminants of concern, exposure pathways and applicable standards); and the data needed to address each decision (e.g., measurements of specific contaminants in soil, water, and air).

The ultimate form of the specifications is a clear statement of the objectives to be achieved through sampling, and quantitative statements of the confidence needed in the results of data collection. These provide the constraints for a statistically-based RI sampling plan designed to meet specifications and give the RPM a measure or "decision rule" for stopping data collection. This will reduce the chances that insufficient or extraneous data are collected.

Reduce the number of field sampling episodes. If data collection is based on general, rather than quantitative, objectives, then after sampling there may still be no definitive basis for answering the question, "Have I adequately characterized the site?" This sets the stage for getting caught in a loop of continuing data collection through unplanned or unanticipated sampling episodes.

Traditional RI sampling has generally involved at least two sampling episodes. The first episode emphasizes determination of the sources and types of contamination and may involve sampling across broad areas to define the boundary of the contamination. Phase II is often used to confirm the presence of specific contaminants, more closely ascertain concentration levels, and estimate locations and volumes of contamination. In addition, Phase II may be used to gather other data such as site physical parameters (soil permeability, pH, etc.) for use in the feasibility study. In the absence of a quantitative sampling design that addresses all major data needs, additional sampling could be required to collect data for needs that were not identified during scoping.

We believe that the statistically-based sampling strategy discussed above may reduce the number of sampling episodes. Unplanned sampling episodes may not be eliminated entirely, but we believe that a quantitative approach to sampling will enable greater consolidation of data needs into fewer sampling episodes, and achieve significant savings in time and data collection costs.

Reduce false starts and rework. Scoping is a complicated activity involving many participants. As indicated earlier, the RPM must reconcile the diverse needs of many interested parties and, with the help of the remedial contractor, develop an effective plan, budget, and schedule for the RI/FS. The MSR revealed that this task was often difficult and frequently involved delays since work plans, quality assurance project plans, and sampling plans were caught in a cycle of review, comment, and rework until some agreement or consensus could be reached on RI data collection activities.

The MSR showed that the use of structured planning, incorporating the suggestions discussed previously, would significantly reduce the time necessary to complete planning documentation. Use of a quantitative approach to defining data needs will produce clear statements of sampling and analysis requirements, which will lead to focused planning documents requiring fewer reviews. The benefits are time and cost saved during the planning process and more effective planning documentation to direct RI/FS implementation. Another key is to mandate up-front participation in scoping by all potential interested groups or data users, followed by early determination of those who really need to stay involved. In this way, only those participants that actually need to be involved for a particular site will contribute throughout scoping and define the data requirements of the RI.

Feasibility Study

As indicated earlier, an ongoing concern of Superfund management has been the time required to conduct the RI/FS. Superfund was interested in finding ways to reduce the duration of RI/FSs from 24–36 months to a new goal of about 18 months for an average site. Another concern was the defensibility of the remedy selection in the Record of Decision.

The MSR identified opportunities to address Superfund's concerns through modifications to the feasibility study. Three separate but related issues were identified. First, a large number of remedial alternatives (e.g., eight to ten) were typically being developed and evaluated for sites, even when the most likely technologies and alternatives were obvious to RPMs from the beginning. Second, the detailed evaluation of alternatives, which can take several weeks or months, often did not begin until after RI sampling was completed. Third, treatability study results were not typically available during the RI/FS. In addition, physical parameters needed to thoroughly evaluate potential remedial technologies often were not obtained, their collection being deferred until the remedial design phase. This meant that important data for evaluating treatment alternatives were not usually available as input to the remedy decision.

To address these issues, the following potential modifications to the feasibility study were identified: start the FS in scoping with a limited number of potential remedial alternatives and increase the use of treatability studies and technology-related data collection during the RI.

Begin Feasibility Study during scoping and reduce the number of potential remedies. Interviews with RPMs indicated that informal considerations of remedial technologies during scoping were typical. Case studies also indicated that sufficient site data and knowledge were usually available to identify likely remedial technologies or alternatives, and these alternatives could be limited to the few (plus the no-action alternative) that were the most likely candidates for the site. This suggested that the evaluation of many remedial alternatives is often unnecessary. Generally, only a few technologies or combinations of technologies comprised the remedial alternatives that realistically had a chance to be selected as the remedy. These technologies were, for the most part, known during scoping.

The FS can be made more efficient by initiating formal evaluations of remedial technologies during scoping and by limiting the number of alternatives evaluated. This approach would evaluate only three to five alternatives initially and perform this evaluation as much in parallel with the RI as possible. If new contaminants are discovered during the RI, then technologies may be added to the remedial alternatives as needed to deal with them. In this way, the evaluation of remedial alternatives becomes a process of starting with what is likely to work and making adjustments as more is learned about the site, rather than trying to screen out a large array of alternatives and justify why they are not likely to work.

In addition, early consideration of remedial technologies allows a special data requirements for engineering parameters or physical site parameters to be defined in scoping and their collection to be scheduled during the RI. These data can then be used during the evaluation of remedial alternatives to provide a more effective and defensible rationale for remedy selection.

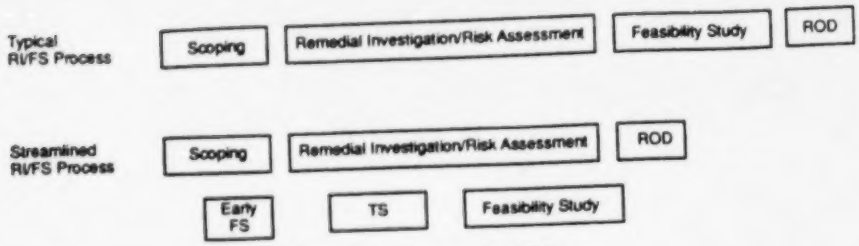

Figure 2. Comparison of scheduling for a typical and a streamlined RI/FS.

Conduct treatability studies during the RI. Historically, bench-scale treatability tests have usually occurred after the RI/FS, during the early stages of the remedial design. This means that a treatment technology has already been proposed as part of the remedy in the Record of Decision, but the effectiveness of the remedy in meeting target clean-up goals has not been demonstrated. We believe that, by starting the FS in scoping, promising technologies can be identified early and bench-scale treatability studies can be conducted during the RI. Since treatability testing is costly and time-consuming, it would generally be conducted for only one or two promising technologies.

Once the need for treatability testing is established in scoping, collection of the samples needed for bench-scale treatability tests can then be scheduled to occur early in the RI, concurrent with other data collection. The results will then be available for use during the detailed evaluation of remedial alternatives and will indicate whether a technology will meet the Applicable or Relevant and Appropriate Requirements (ARARs) and risk-based action levels for the site. If not, the technology can be quickly eliminated from further consideration.

Most important, the treatability tests will reflect the performance of the technology in the media matrix at the site. If the treatment process appears to be effective for the test matrix, the uncertainty of its potential for full-scale effectiveness is reduced. However, it must be acknowledged that treatability testing in the RI/FS may not always eliminate the need for pilot-scale testing later, particularly if the volume of waste to be treated or technology scale-up questions could affect performance.

Using the treatability data and other technology-related data collected early in the RI, the detailed evaluation can be completed shortly after the final RI site characterization results are available. This will reduce the traditional lag between completion of the RI and completion of the FS. The net effect of these changes is to provide the data needed for defensible remedial decisions in a similar or shorter time period as that typically required for an RI/FS. Figure 2 illustrates the scheduling differences between this streamlined RI/FS and a process that was typically used in the Regions.

Conclusion

The Management Systems Review of the Superfund RI/FS produced a systematic definition of a complex process in which environmental data play an important role. Several opportunities for increasing the effectiveness of RI/FS scoping and feasibility studies emerged from analysis of the MSR results. Most of the suggested changes are consistent with improvements already under consideration by the Superfund program.

The proposed changes to the RI/FS are not the only possible improvements to an evolving Superfund process, but the MSR analysis suggests that they have great promise. The practical utility of these results, however, can only be shown by applying them in a pilot demonstration at an actual Superfund site. A Regional partner for such a pilot is currently being sought.

References

1. EPA Order 5360.1, Policy and Program Requirements to Implement the Mandatory Quality Assurance Program, U.S. Environmental Protection Agency, April 3, 1984.
2. The RI/FS Cost Study, Final Report, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC, October 1988.
3. A Management Review of the Superfund Program, U.S. Environmental Protection Agency, Washington, DC, June 1989.
4. D. Neptune, E. Brantly, M. Messner, et al., "Quantitative decision making in Superfund: A data quality objectives case study," Hazardous Materials Control, in press (anticipated publication May–June 1990).

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